Monitoring Klyuchevskoy group of volcanoes (Kamchatka) using seismic noise records

Clara Gómez-García (1), Florent Brenguier (2), Nikolai M. Shapiro (3), Dmitry V. Droznin (4), Svetlana Y. Droznina (4), Victor N. Chebrov (4), and Evgenii I. Gordeev (5)

(1) Earth Sciences Institute Jaume Almera, CSIC, C/ Lluis Solé Sabaris s/n, E-08028, Barcelona, Spain (cgomez@ictja.csic.es), (2) Institut des sciences de la Terre, Université Joseph Fourier, 38041 Grenoble cedex 9, France (florent.brenguier@ujf-grenoble.fr), (3) Institut de Physique du Globe de Paris, Paris Sorbonne Cité, CNRS, 1 rue Jussieu, F-75238 Paris cedex 05, France (nshapiro@ipgp.fr), (4) Kamchatka Branch of the Geophysical Service, Russian Academy of Sciences, 9 Piip Boulevard, Petropavlovsk-Kamchatsky, Kamchatsky Region, Russia (ddv@emsd.ru, dsv@emsd.ru, chebr@emsd.ru), (5) Institute of Volcanology and Seismology FEB RAS, 9 Piip Boulevard, Petropavlovsk-Kamchatsky, Kamchatsky Region, Russia (gordeev@kscnet.ru)

In the last decade, extraction of Green functions from seismic ambient noise has been used extensive and efficiently in different contexts and scales: from imaging to monitoring the Earth's interior and from global to local scales. By using coda waves of noise cross-correlations to estimate travel time perturbations, we can assign changes in delay times to changes in the medium's velocity. Due to this technique attribute of continuous recording of the medium, it can accurately detect very small seismic velocity changes linked to small disturbances in volcano interiors. However, cross-correlation functions (CCF) do not necessary converge to media Green function: measurements of waveforms perturbations within a volcanic edifice are affected by the noise fluctuation.

The Klyuchevskoy volcanic group, located above the edge of the Pacific Plate subducting beneath Kamchatka, is one of the most active clusters of volcanoes in the word. It is characterized by strongly localized volcanic tremor sources, which often dominate the recorded wavefield. To monitor and get measurements of temporal changes of these active volcanoes, we use coda waves of daily CCF from a total of 19 seismic stations from the seismic network operated by the Kamchatka Branch of the Geophysical Service (KBGS) of the Russian Academy of Sciences. Our study period goes from January 2009 to July 2013 in which two eruptions occurred: one from the Klyuchevskoy volcano (2009-2010) and the other from the Tolbachik volcano (2012-2013). After a quality checking of the records and testing different filters, we filter data in the frequency range 0.08 - 7 Hz and we use the Moving Window Cross Spectrum (MWCS) method to measure the relative time shifts. As both eruptions are characterized by emissions of seismic tremors, we avoid the choice of an arbitrary reference CCF: we compute velocity changes between all pairs of daily CCF. We retrieve a continuous velocity change time series for each station pair using a Bayesian least-squares inversion. Several synthetic tests are also carried out to choose the optimal parameters for the inversion and validate the method.